THE FORAGE RESOURCES OF LATIN AMERICA—EL SALVADOR

BY

JAMES M. WATKINS

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ABERYSTWYTH, GREAT BRITAIN

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FOREWORD

This is the first Bulletin in what is to be a series on the forage resources of Latin America. Some of the individual issues of the series will be published in association with the Technical Collaboration Branch of the Office of Foreign Agricultural Relations, U.S. Department of Agriculture, and will be written by members of that Branch now working in Latin America ; others may be written by specialists of the countries of Latin America themselves, others by the staff of the Bureau of Pastures and Forage Crops.

The forage resources of these countries are little known to the outside world, and yet are of direct interest to forage specialists working under a wide range of climatic, soil, and economic conditions. The conditions of Latin America are very diverse, from Mexico through the tropical countries of Central America, of which El Salvador is one, to the great countries of South America, from Venezuela to the Patagonian grazing lands of Argentina. More particularly in South America, the economics of countries such as Argentina, Brazil, and Venezuela depend or have depended to a considerable, if not predominant, extent upon the animal products from great tracts of natural grassland. Some of these resources have not yet been fully used owing to inaccessibility or other factors. The nature of these natural forage resources, the species which compose them, and the types of management used on them, are of interest and possible application in the British African Colonies and Protectorates, and vice versa. It is hoped that the descriptions of conditions and management types in Africa and Latin America which have appeared and will continue to appear in the Bulletins and other publications of the Pasture Bureau will prove of interest, value, and application to forage specialists on both sides of the South Atlantic.

The next issue in this series will be a review based on the literature, memoranda, and correspondence available in the Bureau Library, now being written by Miss G. M. Roseveare, who has devoted much time to the collection and collation of this very scattered information. This will be followed by "The Forage Resources of Latin America : Peru," by Dr. H. W. Alberts, Agricultural Adviser at the American Embassy in Lima, Peru.

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Introduction

From the historical standpoint probably the most important publications on the forage resources of El Salvador are those of Calderón (1923a, 1923b, 1928) and Renson (1913, 1921a, 1921b, 1923, 1929, 1936, 1937). A number of other authors, for example, Choussy (1913, 1943), Escobar (1901), Guirola (1921), and Pico (1937), have indicated certain pasture and forage problems, and Standley and Calderón (1927) report the occurrence of the common grasses and legumes upon which stock live in El Salvador.

This republic is a country of resources that can be advantageously used for the production of domestic animals. There is much land that is not suitable for the production of corn and similar food crops but which can be profitably devoted to livestock. In some areas sufficient water is available, but in others special efforts will have to be made to meet that requirement during the 6-months' dry season. It is an important fact, however, that the country is already supplied with a large variety of forage plants adapted to the conditions. Although some surveys of these plants have been made, it is believed that a review of these findings and the observations made by the writer would be of value at this time. It is the purpose of this paper to present a simple catalogue of these data with the hope that they will be of use in investigational work now in progress in the Latin American Tropics.

Geographic Location of El Salvador

El Salvador lies on the Pacific coast of Central America between 13 and 14·5 degrees north latitude. It is bounded on the northwest by Guatemala, on the north and northeast by Honduras, and on the southeast by the Gulf of Fonseca. Much of the republic has a broken topography, and the mountain ranges act as a barrier to the climate of the Atlantic region, thus partly accounting for the more distinct seasonal effects which prevail on the Pacific coast. (Since this manuscript was submitted for publication, El Salvador has joined with Guatemala.)

Climatic Conditions

There are two seasons in El Salvador : the dry season or summer, which lasts from October until May, and the wet season or winter, which lasts from May until October. The annual rainfall of about 75 inches occurs mostly as daily showers during the winter season. When the rains cease the country becomes very much like a dust bowl, with the exception of the few areas which have small streams for irrigation.

There is no considerable body of temperature data available for the country, but it can be said to be relatively constant throughout the year for any given area. The most striking differences occur with the change in elevation. In the extreme highlands frosts occur at irregular intervals ; these regions may also be affected by the Atlantic coast region and rains sometimes occur at the highest elevations during the summer season.

MEXICO
TROPIC OF CANCER
30°
20°
10°
Br. HONDURAS
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
MEE

Soils and Land Use

Most of the soils of El Salvador are of volcanic origin, differing in colour and texture, depending apparently upon the work of the elements, the type of material and time and kind of eruption that resulted in their deposition. The soils are of varying ages and have, of course, been subjected to environmental factors which have altered them considerably. Throughout the republic, regions of severe erosion are apparent, particularly in the uplands where the mountain sides have been cleared for the production of field crops.

Land use has followed no definite pattern in El Salvador but has been governed primarily by the need for certain crops. Most of the best upland is devoted to coffee, which is the primary cash crop of the country. Cultivated crops such as corn and beans are grown generally over the whole republic, even into the extreme highlands. The land available for livestock consists of certain upland regions where water is available, small farms where feed such as corn and sorghum can be grown, and regions along the coast. The livestock industry is concentrated mostly in the latter regions. While there is a vast amount of additional land which would produce feed during the rainy season, the lack of fodder and also of sufficient water in the dry season prevents the utilization of these areas to any great extent for livestock.

Forage Plants

None of the forage plants discussed in this paper are new to science. They have been described and illustrated in several well-known works. For the convenience of those interested it is suggested that they should consult the works of Bailey (1925), Calderón (1928), Guzman (1924), Hitchcock (1935, 1936), Piper (1934a, 1934b, 1939), and Standley and Calderón (1927).

Grasses

1. *Axonopus compressus* (Swartz) Beauv., zacate de grama (carpet grass).

For botanical description, reference may be made to Calderón (1928) and Hitchcock (1935, 1936). Carpet grass represents one of the most common lawn grasses in El Salvador. While it is a close-growing grass and thrives at the cooler altitudes it has also been observed growing at sea level. Calderón (1928) reports that it grows best at 650 metres, where there is moisture during the major part of the year.

The forage value of carpet grass is somewhat dependent upon fertility of the soil and available water. It is intolerant of drought conditions and becomes very brown in the dry season unless water is supplied. On fertile soils it makes a good growth during the winter and furnishes good grazing. Although it makes a good crop of seed in October and November in El Salvador, the species is most generally propagated vegetatively as a lawn plant. Its utilization as a forage plant is limited to those regions where it grows naturally.

Carpet grass is often found growing with *Desmodium scorpiurus* and *D. triflorum* on upland soils. With better management practices and fertility, such mixtures should be very desirable for upland pastures.

2. *Chloris gayana* Kunth, zacate Rhodes (Rhodes grass).

Although Rhodes grass has been discussed by Tracy (1921) as a promising forage plant for El Salvador, more complete descriptions may be found in the works of Piper (1934b) and Hitchcock (1935). Very little has been done to foster its exploitation in the republic beyond growing it experimentally in the Agricultural Station of the Coffee Association of El Salvador. This test indicates that it can be successfully grown in the region.

The success achieved with this plant as forage in other regions, its drought resistance, high yield and nutritive value, all seem to stress the importance of further tests in this area as a source of additional feed in the dry season.

3. *Cynodon dactylon* (L.) Pers., zacate de grama, zacate de diablo, zacate Bermuda (Bermuda grass).

Discussion and illustrations of Bermuda grass may be found in the publications of Tracy (1922), Calderón (1928), Hitchcock (1935, 1936), and Piper (1934b). Anyone concerned with the agricultural problems of El Salvador cannot overlook Bermuda grass. It occurs on all types of soils from sea level to an elevation of 1,500 metres and it abounds in cultivated fields, pastures, and lawns. It is easily propagated vegetatively or can be reproduced by seed, which is produced in abundance from October to December. Bermuda grass, here as in other regions, serves as a good forage plant, lawn grass, and as a plant for erosion control, but becomes a serious pest in cultivated fields.

4. *Hyparrhenia rufa* (Nees) Stapf, zacate de jaragua (jaragua grass).

Botanical descriptions of jaragua grass appear in the publications of Calderón (1928), Hitchcock (1935), and Renson (1921a). Evidence of its forage value may be found throughout the literature on tropical forage plants, particularly as it relates to the forages of Brazil. Since the introduction of jaragua grass into El Salvador, it has not been necessary to promote its growth as it spreads naturally.

Observations of the cultivation of jaragua in the republic indicate that it is second only to Guinea grass (*Panicum maximum*) as a forage plant. Its tall bunch growth is prominent at the end of the rainy season in October, when it begins to produce seed. Although it is seen mainly at the lower altitudes, it grows well up to around 1,000 metres. Jaragua can be reproduced easily either by seed or vegetatively. Special management is necessary when jaragua grass is used as the main pasture plant since it becomes very woody and unpalatable at maturity. The prevalence of this grass over much of the livestock country and its adaptability to poor soils makes it a most desirable plant for the country.

5. *Ixophorus unisetus* (Presl) Schlecht., zacate de Honduras, zacate de seda, mesmete (mesmete grass).

Reference is made to the works of Calderón (1928), Hitchcock (1936), and Magaña (1921) for botanical description of mesmete grass. The discussions of Magaña indicate that mesmete grass is a forage plant of some value for El Salvador. It occurs in wet areas from sea level to around 800 metres and the maximum growth takes place during the rainy season. Seed setting takes place in October and November.

FIG. 1—Topography of valley just north of San Salvador.

FIG. 2—Topography of Jiboa valley. Intensely cultivated area with Volcano San Vicente on horizon.

FIG. 3—Pasture that has recovered after burning.

FIG. 4—Coffee trees are planted under the large shade trees in this valley and in the front left are seed-beds for coffee trees.

While this plant is limited in its production to small areas, it can be reproduced for forage vegetatively or by seed. Although it becomes woody at maturity, its tolerance to wet conditions and its high yield warrant further trials under conditions similar to those under which Pará grass (*Panicum purpurascens*) is grown.

6. *Melinis minutiflora* Beauvais, gordura, catinguero, capim melado, yaragua, wynne grass, efwatakala, (molasses grass).

Much attention has been given to discussions and descriptions of this grass by Renson (1921b, 1923, 1929), and Calderón (1923a), and also by Hitchcock (1936) and Piper (1909). The characteristics of molasses grass make it specially desirable as a forage plant. Renson (1923) states that it remains green throughout the dry season, smothers competing vegetation, is easy to destroy on cultivated land, is relished by livestock, does well on poor soils, does not need to be burned, produces abundant seed, and can be reproduced by seed or vegetatively. This plant occurs chiefly in regions up to an elevation of 1,000 metres. Under ordinary conditions the seed crop is produced in the dry season in November and December. The writer's observation has been that it is used most commonly as a soiling crop and is rarely found as a dominant pasture plant.

Numerous reports have been made by writers to the effect that this plant is a repellent to ticks and is used in many instances for this reason. Both Calderón (1923a) and Renson (1923) have reported upon this matter concerning molasses grass. The laboratory investigations of Renson (1929) showed that there is a resinous material produced around the hairs on the leaves and many believe that this resinous material causes the tick to die. Further reports are made verbally that the plant also prevents parasites in the animals.

All the foregoing statements and the numerous citations as to the repellent action of molasses grass lead one to believe that the grass may have special qualities. The fact should not be overlooked, however, that no critical tests have been made here to determine the exact reason for these characteristics. This plant deserves further study as to its insecticidal value.

7. *Panicum purpurascens* Raddi, zacate Pará, zacate Egipto, zacate corredor, (Pará grass).

While descriptions and discussions of Pará grass can be found in most of the publications on forage crops, the reader is referred to Calderón (1928), Hitchcock (1935), and Piper (1934a).

Pará grass plays a very important part as a pasture plant in the forage programme in El Salvador. It is one of the common grasses used under irrigation in the coastal region. Being primarily adapted to lands below 500 metres, it is rarely seen in upland pastures. The production of seed in November and December provides seed for sowing, although vegetative reproduction is more common.

The fast-growing habit, high yields, and nutritive value of this grass make it one of the superior grasses of El Salvador.

8. *Panicum maximum* Jacq., zacate de guinea, zacate del barco, zacate barqueño, zacate de la India, (Guinea grass).

Reference for botanical description may be made to Calderón (1928), Hitchcock (1935), and Piper (1934a). The natural occurrence of Guinea grass, its high yield, palatability, nutritive value, and longevity make it one of the top-ranking forage grasses of El Salvador. In July and August it is one of the predominant grasses and is noticeable with its large seed heads, which may continue to appear until October or November. Guinea grass is generally adapted to the lowlands, although it is seen at 800 metres or somewhat higher. Aguilar (1939) in Guatemala reports that it grows at high altitudes but the yields are smaller.

This grass is one of the species most commonly propagated for pastures in the republic. Clones (vegetative pieces) are planted between the rows of corn during the rainy season, and by the time the corn is harvested the grass is well established for a future pasture. It is unusual for seed to be used for establishing stands in this area. The use of vegetative material is in general more satisfactory under the prevailing conditions.

In many of the coastal regions, Guinea grass is used in irrigated pastures. With sufficient stock and rotational grazing, the area can be kept grazed to the proper height to prevent weeds. Where proper management has been followed, these are the best pastures to be found in El Salvador.

9. *Paspalum dilatatum* Poiret, zacate de grama, (Dallis grass).

Although Dallis grass has been listed for El Salvador by Standley and Calderón (1927), more complete information concerning its description may be found in the publications of Hitchcock (1936) and Piper (1934b). It is most noticeable in the coffee regions at the cooler altitudes at about 900 metres, and particularly around the Ahuachapan region. The seed heads can be seen in July and August along roadways and in lawns or pastures which have not been disturbed by grazing or cutting. Its adaptability is somewhat similar to that of *P. notatum* and the two species are often seen growing together.

Dallis grass provides some pasture in the uplands during the rainy season. As with carpet grass, it makes its best growth where plenty of moisture is present. The longevity and persistence of this grass under grazing conditions make it a desirable pasture plant even though the yields are small in comparison to Guinea grass. Its utilization with small legumes in upland pastures needs further study.

Thus far, this grass has not been cultivated for pastures here, although stands may be established readily by seed or by vegetative material.

10. *Paspalum fasciculatum* Willd., camalote, camalote negro, camalote de sombra, (camalote).

A description and discussion concerning this grass can be found in the publication of Hitchcock (1936). Although it has been listed by Calderón (1928) as one of the forage plants of the country, there is little information available in the literature concerning its forage value.

Camalote can be observed growing in low areas where there is plenty of moisture during the dry season. Thus far, it has not been observed growing at elevations above 1,000 metres.

Since camalote becomes woody when it matures seed in October and November, its forage value is dependent somewhat upon the stage of growth. Stock do not relish this plant unless they are forced to eat it ; and, consequently, it has never been used to any great extent. However, when mixed with other grass and fed green it offers additional feed during the dry season. As there are other more desirable plants available, camalote does not seem to be very promising for El Salvador.

11. *Paspalum notatum* (Flügge) zacate de grama, (Bahia grass).

For complete description of Bahia grass, the reader is referred to the publications of Hitchcock (1935, 1936) and Piper (1934a). Calderón (1928) notes that this species is the most common grama in El Salvador. Since Bermuda grass is also called grama and is found growing almost everywhere, the writer questions the validity of this statement.

Bahia grass is seen growing along roadways, in pastures, lawns and waste places. It is more prevalent and seems to grow best at about 700 metres, although it has been observed commonly at low altitudes and sometimes up to 1,000 metres.

Seed production takes place in El Salvador over a long period, but is more pronounced in August and September. The plant is not propagated by seed because this does not germinate well. No explanation has been offered for this characteristic, and Piper (1934a) states that it has prevented its extensive culture in the United States. Propagation of this plant as a sod is the common practice of this region when it is utilized in lawns. The writer has not seen it propagated for pastures.

The forage offered from this grass is limited to those regions where it grows naturally. If it could be propagated easily, it should offer more promise as an upland pasture plant in the same category with carpet grass and Dallis grass.

12. *Pennisetum purpureum* Schum., yerba elefante, zacate elefante, forraje napier, (Napier grass or elephant grass).

The publications of Calvino (1921) and Hitchcock (1935) state that Napier grass has been introduced from Africa into many tropical countries as a source of forage. Data from Calderón (1928) as to its growth in El Salvador indicate it produces better than Guinea or Pará grass, which are two of the outstanding grasses of the country. Its tolerance to drought conditions makes it specially desirable here.

Napier grass occurs chiefly in small patches near roadways, where it is able to survive without much difficulty. It can be propagated easily by vegetative means during the rainy season, even though a good seed crop is usually produced in August and September. It is adapted to elevations of 0 to 800 metres. While no plants have been observed above this elevation,

this does not mean that they would not grow there. Many grasses found here will grow at almost any elevation but are generally best adapted to a definite range of elevation.

The heavy yields of Napier grass and its tolerance to more trying drought conditions warrant its more extensive use for forage under these conditions.

13. *Saccharum officinarum* L., caña de azucar, (sugar cane).

Information concerning the characteristics of sugar cane are to be found in most of the common books on field crops. Hitchcock (1935) gives an account with reference to its habitat and region of cultivation.

Although sugar cane is generally grown for its sugar content, it may be produced for forage in a few instances. In these cases the whole plant is cut and fed green to the animals as one might cut corn for silage. When harvested for sugar, the tops are sometimes fed to the stock when other forages are scarce. With the large amount of cane grown over the republic and the amount of tops available, more use could be made of this material in combination with a good legume as a source of more protein.

The production of sugar cane is concentrated primarily in the regions of low elevation, although it is produced to some extent in altitudes as high as 900 metres. Seed is produced during the summer months of November and December.

14. *Sorghum halepense* L., el zacate Johnson, (Johnson grass).

Reference is made to the publications of Hitchcock (1935) and Piper (1934a) for the botanical characteristics of Johnson grass. As early as 1901, Escobar (1901) suggested Johnson grass as a possible forage for El Salvador, but pointed out that it can either be useful or a serious pest.

Johnson grass appears in all types of habitats, but generally at the lower altitudes. It is often prevalent as a weed in cultivated crops such as rice, corn, or beans. The conditions in El Salvador are ideal for its growth, and it is very difficult to control when once established. Notwithstanding this characteristic, it offers good feed before it matures seed in October and can be used here as a pasture plant or possibly cut and fed green. Because of the difficulty experienced with this plant, it is not to be recommended as forage unless it is already established and cannot be eradicated and replaced by some other plant.

15. *Sorghum vulgare* var. *sudanense* (Piper) Hitchc., zacate de Sudan, (Sudan grass).

Hitchcock (1936) and many others have given descriptions of Sudan grass and have discussed its culture as a forage plant. In El Salvador, Sudan grass is often seeded along with sorghum, or it may become mixed with sorghum, and is thus commonly seen in the same locations and under similar habitats.

Sudan grass is adapted up to elevations of 1,500 metres, but is generally seen at the lower altitudes. When seeded as a pasture plant or as a source of green feed, it produces seed in October and November. It may survive

for 5 or 6 years, depending upon treatment. Sudan grass here, as in the United States, grows rapidly, makes a rank growth, and is excellent feed when it is young and succulent. It should be utilized more as an emergency hay or pasture plant.

16. *Sorghum vulgare* L., alboroto, maicillo, triguillo blanco, triguillo, triguillo colorado, (sorghum).

Discussions and descriptions concerning sorghum are available in most books on field crops. The works of Standley and Calderón (1927) provide information on its use in El Salvador. Aybar (1909) lists three main types for the country : sorghum blanco, sorghum de escoba, and sorghum parecido. For extensive information concerning the growth of sorghum the reader is referred to the work of Vinall (1936).

Sorghum is produced to almost the same extent as corn in the republic. It is best adapted to the low altitudes, but is generally adapted to about the same conditions as corn. Seed may be produced at almost any time during the year, but the general crop matures seed in November and December.

Sorghum plays an important part in the agriculture of this region. The seeds are toasted and eaten with honey, mixed with corn for making tortillas, or mixed with coffee. As a forage plant it is commonly sown with corn. The plants may be harvested and fed green or may be allowed to mature for the grain, and the remaining parts of the plants either pastured off or cut and fed to the animals. The value of this widely used plant as forage may be increased by better means of preservation and by its utilization with legumes.

17. *Sporobolus poiretii* (Roem. and Schult.) Hitchc., (smut grass).

Although this species is not listed for El Salvador by Standley and Calderón (1927), it does occur in the country. It is described by Hitchcock (1935, 1936). It is distinctive in being found only at the high altitudes, and particularly around the volcanoes, San Salvador and Santa Ana, at elevations of 1,000 to 2,500 metres. It grows on poor soils, makes a good growth, and produces seed in December and January.

This plant serves as the main source of forage in these regions for the small number of livestock occurring there. Although it becomes coarse and unpalatable at maturity, with good management and in combination with a legume, it should offer considerable possibilities.

18. *Trichachne insularis* (L.) Nees, (sour grass).

A description of sour grass appears in the publications of Hitchcock (1935, 1936). Sour grass becomes prominent during the dry season in December and January. It grows along roadways, in waste places, and to some extent in pastures. Because of its coarse unpalatable growth, it is not considered to be a valuable forage plant, although it can be used when young and succulent. It is most prevalent at elevations of from 900 metres down to sea level.

19. *Tricholaena rosea* Nees, zacate ilusión, (Natal grass).

Calderón (1928) states that Natal grass is adapted to a wide range of conditions, and is found particularly on the white pumice soils of El Salvador. Its existence on these dry soils agrees with the discussions of Piper (1934a) concerning its growth in the United States.

Natal grass is one of the most picturesque grasses of El Salvador. The wine-red colour of its blossoming seed heads is attractive and can be seen during a large part of the year. It appears to thrive on the upland soils at elevations of 400 to 1,000 metres. Chemical analyses reported by Calderón (1928) indicate that Natal grass is not of great value as a forage plant. Stock do not relish it, but it is eaten well in the dry regions where other forage is scarce.

20. *Tripsacum latifolium* Hitchc. (Tripsacum).

In 1937 Renson (1937) described the production of *Tripsacum latifolium* in El Salvador.* Further discussions are available in the publications of Aguilar (1939) and Hitchcock (1936).

This species of *Tripsacum* is said to have come from southern Mexico and Guatemala. It is adapted to regions below 800 metres and is quite similar to sugar cane in its growth habits. Seed is produced in November and December about the time that sugar cane makes seed.

Of the species of *Tripsacum* available for forage, Calderón (1928) notes that this species is the best. The writer has noted that it makes a rank growth and seems to grow well on poor soils. Both of these characteristics are desirable in a forage plant for the conditions in El Salvador. It is not so palatable to stock as Guinea or Pará grass, but it makes good forage when young. It would appear to be preferable to feed it as green cut forage.

Tripsacum can be easily propagated by clonal material or by seed. Stands should be established during the rainy season. Renson (1937) suggests that, in old stands, it is preferable to allow it to become well established with new growth before the rains cease.

21. *Tripsacum laxum* Nash, arrocillo, (Tripsacum).

Reference is made to Hitchcock (1936) for the botanical description of this species. Calderón (1928) states that it is native to El Salvador, but is inferior to *T. latifolium* as a forage plant. General habitat and method of production are the same as for *T. latifolium*.

22. *Zea mays* L., maíz, guate, (corn).

Hitchcock (1935, 1936) gives a good description of corn, and in the works of Standley and Calderón (1927) may be found discussions concerning the use of corn in El Salvador. Corn is grown throughout El Salvador even to the highest altitudes. The main crop is sown in May and June, and a second crop is often planted in August or September. A third crop is grown in

* Renson (1913) discusses another species, *T. fasciculatum*, for forage in El Salvador, but this species is not listed by Standley and Calderón (1927). It is possible that this species is now known under another name. It has not been observed by the writer.

certain localities in October and November for summer feed, which is called *guate*. In this case the seed is sown very thickly and the material cut while still young, much as one might cut grass for green feed. This material is usually allowed to remain in the sun until it is dark brown in colour and has no doubt lost much of its feeding value, even though it may be the main source of feed during the dry season.

Corn is probably the most important source of forage for El Salvador. It is dependable and can be produced easily by the farmers on all types of soils. Attention should be given, however, to obtaining fodder of high nutritive value and to better methods of preservation.

Legumes

One of the outstanding plant Orders found in the tropics is the Leguminosae. This is particularly true of El Salvador. Nevertheless, pasture or forage legumes are seriously lacking in the tropics, and special attention requires to be given to evolving methods of utilizing the legumes now to be found in these regions.

The value and need of legumes in El Salvador have been stressed in the work of Renson (1936). Others have also encouraged the use of more legumes, but have not preceded their suggestions by experiments to show their value here. For instance, the existence of *Desmodium rensoni* in El Salvador has been much discussed, and it is believed to be a desirable forage plant. At present it is used very little because of lack of knowledge concerning its management and growth. Until such matters can be worked out, other legumes such as cowpeas, which are not difficult to grow, should be utilized.

Some of the legumes now found in El Salvador are as follows :—

1. *Cajanus indicus* Sprengel, alberja, alberga, cachito, frijol de palo, (gandul or pigeon pea).

The characteristics of pigeon pea are given by Bailey (1925) and Standley and Calderón (1927). Pico (1937) makes the following statements as to its forage value: (*a*) it has a high nutritive value and compares favourably with alfalfa ; (*b*) it is adapted to all classes of soil ; (*c*) it produces large quantities of forage ; (*d*) it is high in protein ; and (*e*) it can be substituted for concentrates.

Observations of the pigeon pea made by the author indicate that it is a forage legume which needs exploitation, and that it should be used more widely in El Salvador. It is easy to grow, and is adapted to elevations up to around 1,500 metres ; seed crops can be produced over a long period of the year as long as sufficient moisture is available. The pigeon pea seems to be a promising emergency legume for El Salvador. Tests are needed to determine the best varieties and methods of growing for local conditions.

2. *Canavalia ensiformis* L., abono negro, chilipuca montes, (jack bean).

The reader is referred to the work of Piper (1939) for discussion of the jack bean and its botanical characteristics.

The jack bean has been used in a number of places in El Salvador as a green manure crop. It is apparently adapted to all types of soils and is drought resistant. Although it has been most generally observed at 200 to 1,000 metres, it can be grown at higher altitudes. The time of seed production is generally determined by the elevation and the time of seeding, but a seed crop is usually produced during the dry season. The experience with this plant for forage has been limited. Piper (1939) states that favourable reports were given from feeding trials in Hawaii. Because of the good growth obtained in El Salvador, it is probable that it could be used for forage here.

3. *Desmodium rensoni* Painter, barajillo, varajillo, vara de acro, pie de paloma, vara blanca, juana de arco, gutao, engorda caballo.

Renson (1936) has given a complete description of barajillo, and has studied its growth in El Salvador as a forage plant. Choussy (1943) has also made extensive studies of its forage value. Unfortunately, the many discussions and constant recommendations of this plant for forage were not preceded by tests which revealed the best methods of growing and managing it for forage. Neither have digestibility trials been conducted to determine its actual feeding value, even though chemical tests (Calderón, 1928, and Choussy, 1943) have shown that it is very high in protein.

Barajillo is the type of plant which seems to be much more promising as forage for El Salvador than the other available perennial legumes. It is rarely found under constant grazing because no seed is produced and the plants are said to be killed out by the grazing. Consequently, it is usually seen along fence rows. Plants are found up to around 1,000 metres, and seed is produced in November and December. Investigations have shown that it can be propagated vegetatively, but this method is not as satisfactory as establishing it from seed. Renson (1936) suggests that the seed should be cleaned of the husks to promote good germination. Barajillo makes an excellent appearance for a browse legume, and it is believed that when sound methods have been determined for managing it and producing seed it will be a valuable legume.

4. *Desmodium scorpiurus* (Swartz) Kuntze, trencilla, hierba de Santa Teresa, hierba del medico.

Standley and Calderón (1927) report that this species is common in all parts of El Salvador. It has been observed by the writer mostly in areas which are kept grazed down or in lawns where the grass does not grow very high. It often occurs with carpet grass, and with Bahia grass, particularly in the cooler regions around 800 metres.

Little attention has been given to its use for forage, and its utilization is limited to those regions where it occurs naturally in pastures. Although it is not reproduced for forage, it produces an abundance of seed in November and December, and can be propagated by seed or vegetatively. Its appearance is similar to that of red clover, and it should be useful in upland pastures when mixed with a grass such as carpet grass.

5. *Desmodium triflorum* (L.) Kuntze, hierba cuartillo.

Standley and Calderón (1927) list this species as a common legume in El Salvador. Its growth is similar to that of *D. scorpiurus*, but it is an inferior plant and makes less growth. Statements made above regarding *D. scorpiurus* concerning growth, use, and value would apply to *D. triflorum*.

6. *Dolichos lablab* L., frijol de adorno, el caparo, (bonavist, lablab, or hyacinth bean).

Reference is made to Piper (1915) for the botanical description of this plant. The hyacinth bean has been grown successfully in El Salvador primarily as a food plant. It is generally adapted to all types of soils at elevations of 300 to 1,500 metres. The main crop of seed is produced in the dry season, although seed is sometimes produced at other periods as well.

Although this plant has not been produced here primarily for forage, it has been used successfully in this way elsewhere, and should offer some promise in El Salvador as well as many other parts of Latin America. Plants grown at the Experiment Station in La Ceiba made mammoth growth and appeared to be excellent for these conditions.

7. *Pachyrhizus erosus* (L.) Urban, jicama, (yam beans).

Yam beans are listed in the work of Standley and Calderón (1927). A more complete discussion and description can be found in the publication of Bailey (1925). This plant is grown primarily for the edible root in El Salvador. Recent investigations indicating that the seeds contain a rotenoid substance have caused considerable interest, and have stimulated further investigations to determine the value of the seed for insecticidal purposes.

Yam beans are adapted in general to regions below 600 metres. They are often observed on poor clay soils near the Lempa River, and on the upland volcanic soils. The bean is prevalent in Guinea and Pará grass pastures and stands out prominently in December and January, when it produces seed. The value of this plant for forage is somewhat questionable, since it has not been observed to be grazed when associated with grass. The root is sometimes utilized for feed during the dry season, and the value of the legume to the grass warrants its use in pastures. Further investigation is needed to determine its forage value.

As noted above, yam beans are generally cultivated as a vegetable. Seeds are sown in August, and roots are harvested in October and November. For seed, the crop must be allowed to grow until January. The best crop of seed has been produced in La Ceiba from seed planted in April and harvested in January. Regardless of the time of seeding, the crop of seed is usually produced in November and December. The roots can be retained over the dry season and replanted for a seed crop the second year.

8. *Phaseolus vulgaris* L., frijol, ejote, (beans).

Standley and Calderón (1927) have discussed the botanical characteristics and general use of beans in El Salvador. There are many different varieties available for use in the republic. They are in general adapted to the same conditions as corn.

With the shortage of leguminous feed in El Salvador and the great amount of beans produced, some system could be established for making more use of the bean vines for feed. With preliminary studies this plant could easily serve as an emergency forage plant.

9. *Soja max* Piper, frijol de soya, (soybeans).

Thorough studies have been made of the soybean by Piper (1939) and others concerning its use as a forage plant. Little investigation has been undertaken to determine its value in El Salvador, other than to show that it can be grown. Calderón (1928) lists the soybean as a possible forage plant for El Salvador, and Choussy (1913) discusses its growth.

The value of soybeans as a forage has been proved many times. Varietal testing is needed to determine the best forage varieties for local conditions.

10. *Vigna unguiculata* (L.) Walpers, frijol de maiz, caupi, (cowpea).

Descriptions and discussions concerning the growth of cowpeas may be found in the works of Piper (1939). Hill (1913, 1925) has given evidence that they have a definite place in the agriculture of El Salvador.

Cowpeas are best adapted to low altitudes and warm climates. Sufficient tests have been conducted to show that they can be produced at almost any time during the year, provided sufficient moisture is available. The feeding value and the rapidity of the growth warrant their greater use as an emergency forage plant for supplemental feeding.

Supplemental: Before leaving the subject of forage legumes in El Salvador, mention should be made of a group of plants which go under the name of *choncho*. They are herbaceous, viny legumes, which are prominent with fruiting pods during the dry season. They grow on fence rows, twine on trees, and some are seen in pastures, especially in association with Guinea grass pastures. These plants include such genera as *Galactia*, *Rhynchosia*, *Calopogonium*, and *Bradburya*. Some of these plants may offer promise for forage with further investigation and tests. Their ability to compete with a plant like Guinea grass makes them specially attractive for pastures.

MISCELLANEOUS PLANTS

1. *Crescentia alata* H.B.K., morron, morrito, cutuco, cuchara.

Reference is made to Standley and Calderón (1927) for discussion of the botanical characteristics of this tree. Morron occurs primarily at elevations of 100 to 600 metres on poorly drained soils, especially over the Lempa River region and near La Union. The prevalence of this plant on poorly drained soils does not agree with the consensus of opinion usually expressed.

The large round fruits which are produced, generally from August to March, have many general uses. When the fruits are dry, seeds are removed and the "grounds" are cut into different shapes to serve as kitchen utensils. The fruits which drop to the ground are eaten whether green or in a fermenting condition by the stock during the dry season. In certain areas during the

dry season these fruits may be practically the only source of food for the stock. Standley and Calderón (1927) report that this tree is very common in the Department of Chalatenango, and that the good quality of cheese coming from this region is attributed to their fruits being eaten by the animals.

2. *Melanthera aspera* (Jacquin) Steudel, orozuz, melanthera.

This plant is listed by Standley and Calderón (1927) as common in some parts of El Salvador. It is a herbaceous plant which occurs in pastures and along fence rows. Since it is eaten by stock, it is believed to have some forage value for El Salvador. It is adapted to regions up to around 1,500 metres and produces seed at the beginning of the dry season. This plant, like many others in the country, needs to be studied further to determine its value and the proper method of handling it for forage.

3. *Musa sapientum* L., guineo de seda, guineo patriota (banana).

The reader is referred to Bailey (1925) for a botanical description of the banana plant, and information is available in many books of tropical agriculture concerning its growth. The banana plant is prevalent over most of the lowlands of the tropics. It is cultivated primarily for the fruits under most conditions. In El Salvador, however, farmers commonly grow an area of bananas which can be cut and fed to the stock during the dry season. Chemical analyses, as shown by data from the United Fruit Company in Honduras, indicate that banana leaves are extremely high in water content (around 95 per cent), and are, consequently, low in feeding value. Nevertheless, this plant does serve a good purpose in the feeding of the stock, as a source of water, roughage, and some nutritive value.

Supplemental: There are other plants in El Salvador that are of minor value which might be included here. It has not been felt, however, that they warrant exploitation in comparison with some of the other forages available.

Conclusions

The foregoing discussions concerning the forage resources of El Salvador are an indication of the many plants available for use in the republic. The introduction of more forage plants may also add to the desirable forages and simplify some of the problems. A grass like Rhodes grass, for instance, may be more satisfactory for grass-legume mixtures than are some of the grasses now available.

The immediate problems for improving the forage situation are :—

(*a*) the use of more legumes ;

(*b*) the use of more grass-legume mixtures ;

(*c*) the development of more efficient pasture management ;

(*d*) the use of lime and fertilizers ;

(*e*) the development of forage for particular conditions ; and

(*f*) the all-inclusive matter of producing and preserving more feed for the dry season.

The realization of the value of legumes in all agricultural programmes is centuries old and it is always surprising to find that they are so often lacking in sufficient quantities in our programmes. The whole agricultural situation in El Salvador could be placed on a more sound basis by the growth of more legumes. This is particularly true of the forage programme. One solution to this problem may be found in the use of more browse legumes. The indications are that barajillo may have great possibilities in this respect when growth and management procedures have been determined for this plant.

While the inclusion of legumes has been stressed, the growth of legumes with grasses is a practice which should be encouraged. There are many advantages from such a practice, such as the increase in yield per unit area, the more desirable feed, better stands, better control of weeds, and the additional soil-building qualities of a leguminous crop.

Good pasture management is followed to some extent in the irrigated sections where green pastures may be managed throughout the year. Even so, the use of more rotation of pastures to keep the grass or forages at the best height is a problem which needs further investigation. Many of the pastures are at one or other extreme, overgrazed or ungrazed. They are often undergrazed to such an extent that weeds occupy a large part of the area devoted to pasture. Many stockmen follow the practice of burning off the pastures during the dry season. While this practice has certain advantages, it destroys much of the organic material and injures the plants to some extent. With proper management, the carrying capacity of the available land could be greatly increased in El Salvador and the stock considerably improved. By the use of different forages the uplands can be better utilized, thus leaving some of the good coastal lands for other more profitable crops. Much of the best land in the republic in the coastal regions is placed under irrigation for pastures. Pasture is naturally needed during the dry season, but it would appear that more profitable use can easily be made of the land.

Lime and fertilizer have not been used for pastures to any extent in this region. It is generally believed that the farmer cannot afford to use them for pastures at the current prices. There is no doubt about the need for both when the condition of the stock and the high mortality rate are noted. However, investigations are needed to determine the extent to which lime, phosphates, and potash can be used economically.

With sharp changes in elevation from one region to another and their effect upon the growth of plants, there is a definite need for plants for each particular type of region. The occurrence of *Sporobolus poiretii* only at high altitudes is an indication that plants should be grown in the regions to which they are best suited. Some of the desirable forages of other countries in the temperate zones may probably be valuable in the high altitudes here.

For a region characterized by such a need for forage during the long dry season, the seriousness of the situation has not been appreciated. At the end of the dry season the thin appearance of the stock is usually indicative of the lack of feed and the deficiencies connected therewith. There are many possibilities for avoiding this difficulty. The use of silage is almost unheard

of in some localities and the preservation of feed as hay is not practised to any great extent. Both of these methods of preservation could be utilized without much additional expense and would lead to profitable returns. The planning of a programme for the better use of plants which are adapted to the dry season, and the combined preservation of feed offer possibilities of bridging the gap which is the major forage problem of El Salvador.

Summary in Spanish

En este Boletín se indican las muchas plantas que pueden tener valor en calidad de forraje en la República de El Salvador, estimandose que seria deseable la introducción de especies como el zacate Rhodes (*Chloris gayana*), porque tales especies pueden ser utilizadas para hacer mezclas de gramíneas y leguminosas con resultados mucho más satisfactorios que los de algunas de las especies ya disponibles. Para mejorar la presente situación forrajera, se proponen estas medidas inmediatas :

(*a*) Empleo de más leguminosas.

(*b*) Empleo de más mezclas de gramíneas y leguminosas.

(*c*) Desenvolvimiento de una más eficiente administración de los pastos.

(*d*) Empleo de cal y abonos.

(*e*) Fomento del forraje para situaciones peculiares.

(*f*) Producción y conservación del forraje para la estación seca.

La situación agrícola, como un todo, en El Salvador, podria ser colocada sobre bases mucho más solidas gracias al empleo de más leguminosas, particularmente en la producción del forraje, y acaso fuera tambien posible el utilizar más ramas forrajeras.

Seria prudente mejorar la administración de los pastos, asi como el implantar una rotación de potreros, con objeto de mantener la hierba a la altura que sea mas conveniente. Numerosos pastizales se encuentran en uno de los dos extremos : en exceso o defectuosamente repastados ; y en algunos casos, la falta de apacentamiento es tan notable que predominan las malezas. La quema que se viene practicando, aunque posee ciertas ventajas, destruye a una gran parte del material orgánico y perjudica al herbaje. Con una administración apropiada, la capacidad productiva de la tierra disponible pudiera aumentarse grandemente, asi como mejorarse la condición del ganado. La gravedad de la situación, para una región que se caracteriza por una necesidad tal de forraje durante la estación seca, no se ha venido apreciando debidamente. La magra apariencia del ganado al final de la estación seca, indica una escasez general de alimentación y la existencia de defectos. Estos problemas pueden ser superados mediante una selección de las ya adaptadas especies de gramíneas y leguminosas, mediante la practica de una correcta administración de los pastizales y mediante la introducción de la conservación del forraje, para cubrir las necesidades de la estación seca.

SUMMARY IN PORTUGUESE

Indicam-se neste Boletim as numerosas plantas que podem ter valor como forragem na República do Salvador. Julga-se prudente introduzir outros géneros taes como a capim de Rhodes (*Chloris gayana*), dado a possibilidade de servirem estes géneros melhor para misturas de gramíneas e leguminosas do que algumas que se obteem actualmente. As medidas immediatas que se propõem para melhorar a situação a respeito da forragem são as que se detalham a seguir :

(*a*) O uso de mais leguminosas.
(*b*) O uso de mais misturas de gramíneas e leguminosas.
(*c*) O aperfeiçoamento do serviço de pastagem.
(*d*) O uso de cal e adubos.
(*e*) O desenvolvimento da forragem para condições especiaes, e
(*f*) A produção e conservação da forragem para a estação seca.

Colocar-se-ía a situação agraria inteira da República do Salvador sobre uma base mais sã usando mais leguminosas, sobretudo na produção de forragem, podendo-se egualmente usar mais ramas forrageiras.

Seria prudente melhorar a direção da pastagem e organisar pastagens de rotação afim de que as ervas tenham a altura mais conveniente. Muitas pastagens apresentam um ou outro destes extremos : a utilisação excessiva ou a utilisação insuficiente, dando-se o caso de abundar a erva má onde ha pastagem insuficiente. Pratica-se a eliminação pelo fogo, mas, apesar das suas vantagens, este método destroe muito material orgánico e prejudica o pasto. Havendo uma direção adequada, é possivel aumentar a productividade da terra disponivel e melhorar consideravelmente a condição do gado. Para uma região caracterisada por tão grande necessidade de forragem durante o longo período da seca, ainda não se apreciou a gravidade da situação. O aspecto magro do gado ao fim da estação seca indica a falta geral de alimento e a existencia de deficiencias. Podem-se superar esses problemas pela escolha de especies adequadas de gramíneas e leguminosas, pela organisação de uma direção eficiente e pela conservação da forragem afim de satisfazer as exigencias no período da seca.

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